

Enhancement of MRC Modelling Tools in the 3S Basin to Improve Transboundary River Basin Management

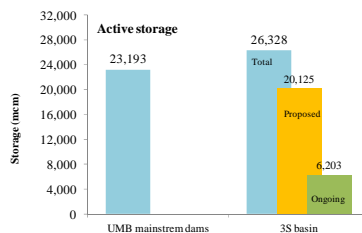
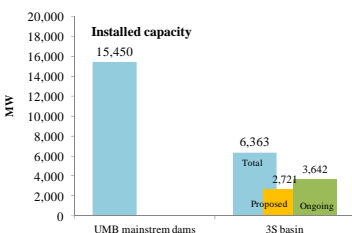
The Srepok, Sesan, and Sekong (3S) Basin

The 3S Basin drains an area of 78,650 km² :

- Viet Nam (38%),
- Cambodia (33%),
- Lao PDR (29%).

The basin contributes up to 20% of annual water flows to the Mekong mainstream and provides an important contribution of aquatic biodiversity and ecosystem services to the downstream (Tonle Sap Lake and Mekong Delta), especially with regards to fish habitats (rapids, deep pools and sand bars) and migration routes.

Presently, the basin is threatening by accelerating hydropower development and extreme events from climate change. There are currently nine operating dams, 11 projects under construction and 21 other planned projects with a total installed capacity of 6,400 MW and a total active storage of 26,328 10⁶ m³. The total active storage is comparable to the existing and ongoing dam development in the Upper Mekong basin in China.



Objectives of study

To enhance MRC modelling tools to quantify the potential impact of hydropower development, operations, and climate change on flow regimes. Potential flow changes are presented and used to discuss consequence impacts and transboundary implications.

Modelling tools

MRC-SWAT modelling

The Soil and Water Assessment Tool (SWAT) model set up by the MRC was chosen for simulating natural flows in the 3S Basin. The model is a part of the MRC Decision Support Framework and ToolBox for the Lower Mekong Basin planning. The model was calibrated and verified with observed flow data from 1986 to 2006. Furthermore, the model was used to assess flow changes from the projected climate change scenarios.



UC-HecResSim modelling

The simulated natural flows of each sub-basin from the SWAT model under observed and projected climate were then used as inputs to the HEC-ResSim hydropower and reservoir simulation model set up by the University of Canterbury (UC). The model was used to simulate regulated flows and power production for various hydropower operation rules and development levels. HEC-ResSim was also added to the MRC ToolBox.

Potential changes in flows from hydropower development and climate change scenarios were compared against a baseline scenario (BL) without hydropower power projects.

Climate change and hydropower development impact on flow regimes

No dams under the following climate scenarios were compared:

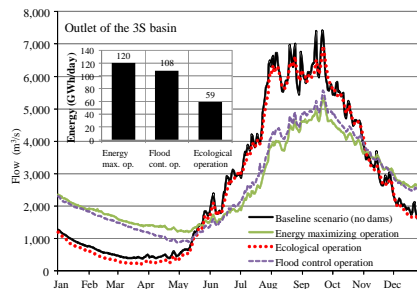
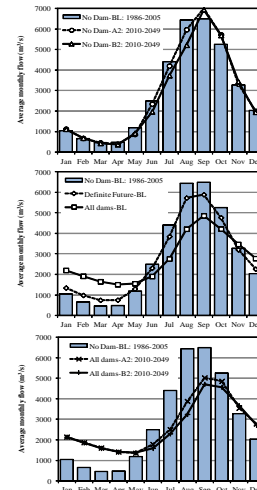
- No Dam-BL: no dams under baseline climate
- No Dam-A2: no dams under future climate (A2 scenario)
- No Dam-B2: no dams under future climate (B2 scenario)

Key outcomes: Climate change results in less flows Jun.-Aug. and greater flows Sep.-Nov.; a clear shift of the peak flows by about a month. No significant change in dry season.

Hydropower development under the maximum energy production rule were also compared:

- Definite Future-BL: definite future dams under baseline climate
- All dams-BL: all dams operating under baseline climate (1986-2005)
- All dams-A2: all dams operating under future climate (A2 scenario)
- All dams-B2: all dams operating under future climate (B2 scenario)

Key outcomes: Dams will modify the average monthly flow distribution dramatically by decreases wet season flows and increases dry season flows. The operation of full hydropower development under climate change conditions changes monthly flow patterns by a similar magnitude as all dams without climate change, but a slight shift in monthly peak flows occurs.



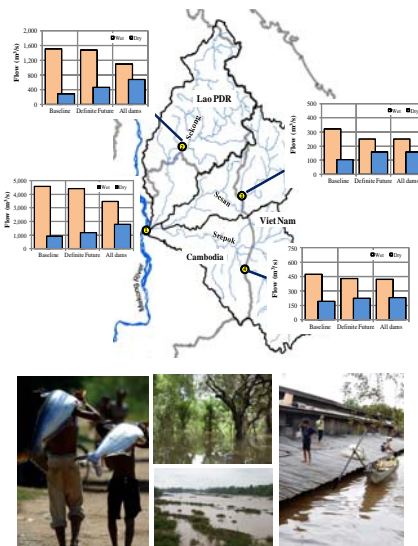
Impact of dam operations

Operations to maximize energy production by storing excess flows in the wet season to allow for an increase in potential power generation in the dry season, results in the largest modification of seasonal flow patterns. Keeping water level at the full reservoir level all times to act like a run-of-river type scheme (Ecological Operation) results in minimum changes to baseline flow patterns. However, this operation will reduce energy production by half compared with the maximize energy operation

Transboundary implications

Existing dam operations in the Sesan River have already caused high fluctuations of water levels downstream, changes in water quality, a major decline of fish populations and species. The simulations show that hydropower development and operation will change the seasonal flow patterns at the country boundaries significantly from the baseline conditions and also cause water level changes in the Mekong mainstream.

Change in flow regimes from full hydropower development and climate change in the 3S Basin is of great concern because it will impact habitat and livelihood downstream by reducing wetland areas in the flood season, submerging sandbars, changing river morphology, and altering river bank vegetation. These changes, together with alteration of fish migration routes and sediment flows, could lead to a subsequent level of decrease of ecological and fish productivity in the Tonle Sap and in the Mekong Delta



The assessment of changes in flows and water levels is essential, but it is only an initial step to examine impacts from hydropower development. Coordination and cooperation among countries is essential to build a comprehensive understanding of the importance of economic, environmental and social values and assets of the basin to provide more comprehensive strategic options for dam development and operation as well as to prepare climate change adaptation plan.